Faculty of Manufacturing Engineering

DEVELOPMENT OF LUMBAR SUPPORT DEVICE USING MALAYSIAN ANTHROPOMETRY DATABASE AND ITS PHYSICAL AND PHYSIOLOGICAL EFFECTS

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A thesis submitted
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DECLARATION

I declare that this thesis entitled “Development of Lumbar Support Device Using Malaysian Anthropometry Database and Its Physical and Physiological Effects” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……

Name : ……...

Date : ……

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Manufacturing Engineering.

Signature	:	……
Supervisor Name	:	……
Date	:	……

DEDICATION

I dedicated this thesis to my parents. I hope that this achievement will complete their dream on me for all those many years ago when they chose to give me the best education they could. All of this achievement just for them.

Thank You So Much and Love Both of You Forever.

ABSTRACT

Nowadays, competitions between industries benefit the global economically. However, the workers were working repetitively in awkward posture and heavy lifting could potentially increase the cause of lower back pain (LBP) and musculoskeletal disorder (MSD). Intervention using the lumbar support system is among the methods that could solve this issue and improve the safety and comfort of the workers. Therefore, this research aims to focus on the development of the lumbar support device for industrial workers using the Malaysian anthropometric data. Currently, lumbar support is one of the tool examples which have been used to reduce the LBP issue in the industry, but how far this support device can effective to reduce this issue. Thus, the functionality of surface electromyography (sEMG) is used to detect muscle function or muscles activity through electrical stimulation. Consequently, the analysis of muscle of workers through sEMG was proposed to detect the functionality of an application of current lumbar support. The data were collected through surveys among 45 layup workers in the aerospace composite manufacturing industry. The qualitative and quantitative data were collected. From the data that were sorted, the respondents were validated using sEMG and heart rate monitor to detect the biomechanical factors that contribute to fatigue during working. Beforehand, the anthropometric data was developed in the early designing stage. The design of new lumbar support was followed process of anthropometry data collection, design, material selection and validation. The manipulated variables are the workers that without, with current and new lumbar support device. The sEMG data can measure and validate the muscles activity values during work based on these three variables. From this study, the level of pain faced by workers in moderate and very pain at lower back muscle was 59% and 17% of workers. In biomechanical factors of sEMG and heart rate (HR) have a significant effect on HR3 and HR4 at the end of the working day. The parameter that used in designing new lumbar support device were biacromial breath, neck height, chest height, waist height, trochanterion height, chest circumference, waist circumference, buttock circumference, and scye circumference. The result of this work is producing the comparison data to design the new lumbar support device, the reducing of amplitude value was 60.57% compared to workers that not wearing this device while 56.33% compared to workers that wearing current lumbar support device. This device resulted to reduce the LBP problem in industries and methods of this study contributed to society which are anthropometric database and muscle activities.

ABSTRAK

Pada masa kini, persaingan antara industri memberi manfaat kepada ekonomi global. Walau bagaimanapun, pekerja harus bekerja berulang-ulang dalam posisi yang tidak baik dan mengangkat berat berpotensi dapat meningkatkan sakit belakang dan gangguan muskuloskeletal (MSD). Penggunaan sistem sokongan lumbar adalah antara kaedah yang mungkin dapat menyelesaikan masalah ini dan meningkatkan keselamatan dan keselesaan para pekerja. Oleh itu, matlamat kajian ini bertujuan untuk memberi tumpuan kepada perekaan sokongan lumbar bagi pekerja perindustrian dengan menggunakan data antropometri Malaysia. Pada masa ini, sokongan lumbar adalah satu contoh alat intervensi yang telah digunakan untuk mengurangkan masalah sakit belakang di dalam industri tetapi sejauh mana peranti sokongan ini berkesan untuk mengurangkan masalah ini. Oleh itu, fungsi elektromilogi permukaan (sEMG) digunakan untuk mengesan fungsi atau aktiviti otot melalui rangsangan elektrik. Oleh itu, analisis tentang otot pekerja menggunakan sEMG dicadangkan bagi mengesan fungsi penggunaan sokongan lumbar pasaran. Data dikumpulkan berdasarkan uji kaji di kalangan 45 pekerja dalam industri komposit aeroangkasa. Data kualitatif dan kuantitatif dikumpulkan. Dari data yang disusun, responden yang terpilih membuat uji kaji akan menggunakan monitor kadar jantung dan sEMG untuk mengesan faktor biomekanik yang menyumbang kepada kelesuan semasa bekerja. Sebelum itu, data antropometri telah dikaji dalam merancang di peringkat rekaan. Reka bentuk sokongan lumbar baru menggunakan data anthropometri, reka bentuk, pemilihan bahan dan pengesahan produk. Pembolehubah yang dimanipulasi adalah pekerja tanpa sokongan lumbar, dengan sokongan semasa dan baru. Data sEMG permukaan dapat mengukur dan mengesahkan nilai aktiviti otot ketika bekerja berdasarkan tiga pembolehubah ini. Dari kajian ini, tahap kesakitan yang dihadapi oleh pekerja dalam sederhana sakit dan sangat sakit pada otot belakang adalah 59% dan 17% bilangan pekerja. Dalam faktor biomekanik, sEMG dan kadar denyutan jantung (HR) mempunyai kesan yang signifikan terhadap HR3 dab HR4 pada penghujung pekerjaan. Parameter yang digunakan dalam mereka bentuk peranti sokongan lumbar baru adalah "biacromial breath, neck height, chest height, waist height, trochanterion height, chest circumference, waist circumference, buttock circumference, and scye circumference". Hasil kerja ini menghasilkan data perbandingan untuk merancang peranti sokongan lumbar baru, pengurangan nilai amplitud adalah 60.57% berbanding pekerja yang tidak memakai alat ini manakala 56.33% berbanding pekerja yang memakai peranti sokongan lumbar kini. Peranti ini dijangka dapat mengurangkan masalah sakit belakang di industri. Kaedah kajian ini dapat menyumbang kepada masyarakat yang merupakan data antropometrik dan aktiviti otot.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES